

Contemporary Approaches to Isokinetic Strength Assessments in Professional Football Players

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Abstract

To assess traditional and novel isokinetic strength characteristics of the eccentric knee flexor (eccKF) and concentric knee extensor (conKE) musculature, 26 professional football players completed bilateral conKE and eccKF contractions at angular velocities of 180, 270, and 60 °·s⁻¹. Peak torque (PT), angle of peak torque (APT), angle-specific torque (AST) analysed every 10° between 40 and 70°, functional range (FR), and dynamic control ratios (DCR) calculated from both the PT (DCR_{PT}) and AST data (DCR_{AST}) were analysed. The PT, APT, and FR data elicited significant contraction*angular velocity interactions ($P < 0.001$). Significant main effects for contraction*angular velocity*angle and contraction*angular velocity*limb*angle interactions ($P \leq 0.001$) were identified for AST data. The DCR_{PT} data elicited a significant main effect for angular velocity ($P < 0.001$) and limb ($P = 0.018$), whereas the DCR_{AST} data was significantly different across angles ($P < 0.001$) and elicited a significant ($P = 0.002$) limb*angle interaction. Traditional analysis variables utilised for isokinetic strength assessments in football may not be appropriate and/or sensitive enough to identify injury risk. Practitioners should utilise the novel metrics proposed in the current study and conduct assessments across a range of joint angles and angular velocities.

Key Terms

Screening, Peak torque, Injury risk, Angle of Peak torque, Dynamic control ratio

1.0 Introduction

Epidemiological research into high-intensity intermittent team sports including soccer (football) has consistently identified knee ligamentous and thigh muscular strain injuries to be most prevalent (Woods et al. 2004; Renstrom et al. 2008; Ekstrand, Hagglund and Walden, 2011). These injuries can lead to large financial (Mather et al. 2013) and time loss implications (Walden et al. 2016). Walden et al. reported that only 65% of professional male players that sustained an Anterior Cruciate Ligament (ACL) injury were able return to previous competitive levels. The aetiology of knee ligamentous, knee flexor and extensor muscular injury has consistently identified reduced muscle strength as a risk factor (Nielsen and Yde, 1989; Croisier et al. 2008; Van Dyk et al. 2016).

The assessment of knee extensor and flexor strength is often conducted using isokinetic dynamometry. However, literature to date has identified a limited association between injury incidence and the commonly utilised isokinetic indices of strength (Bennell et al. 1998; Sharira et al. 2016). This lack of association might be attributed to the ways in which isokinetic strength characteristics are typically assessed and quantified. One of the most commonly utilised isokinetic metrics is that of peak torque (PT), which represents a single maximum to describe the torque-angle relationship at a predetermined velocity. This peak value negates an understanding of the sensitivity of strength to changes in angle, or how strength is maintained over the predetermined angular range. The angle of PT has been reported at $\sim 70^\circ$ (from full extension) during concentric knee extensor contractions and $\sim 35^\circ$

for eccentric knee flexor contractions in football players (Small et al. 2010). This lack of angular coincidence has led to the development of angle-specific derivations of dynamic strength ratios (El-Ashker et al. 2015; Evangelidis et al. 2015). The use of angle-specific torque data has been advocated more broadly, given the increased risk of musculature and ligamentous injury at extended knee joint angles (Boden and Dean, 2000; Olsen et al. 2004; Hewett and Myer, 2011; Chumanov et al. 2012; Higashihara et al. 2015). However, whilst angle specific measures of isokinetic strength have been assessed in recreational and semi-professional football populations (Cohen et al. 2015; El-Ashker et al. 2015; Evangelidis et al. 2015), this profiling has not included professional players.

An additional metric often reported in isokinetic analyses defines 'work' as the integral of the torque-angle curve, which Dvir (2014) considered of little relevance given its strong correlation with PT and the influence of (predetermined and standardised) range of motion. However, the capacity to quantify the maintenance of strength throughout an angular range would have clinical relevance. The predetermined angular velocity is also a methodological issue in isokinetic dynamometry, with assessments often conducted at low angular velocities of $\leq 120^{\circ}\cdot\text{s}^{-1}$ (Small et al., 2010) representing limited functional relevance. The most common mechanism of non-contact lower-limb injury in football is running (Ekstrand et al., 2011), characterised by knee angular velocities of up to $400^{\circ}\cdot\text{s}^{-1}$ (Nedergaard et al., 2014). Whilst the choice of angular velocity is ultimately limited by the dynamometer used, an inclusion of higher angular velocities is advocated.

When considering aetiological risk factors for lower limb injury in soccer, the current practices associated with isokinetic strength assessments may not be entirely suitable for identifying injury risk. Angle specific strength assessments across a range of angular velocities may offer a better method of identifying strength deficits/imbbalances specific to the injury mechanisms and, in turn, provide additional information pertinent to injury prevention strategies.

With implications for current strength screening practices, the aim of this study was to assess traditional and novel isokinetic eccentric knee flexor (eccKF) and concentric knee extensor (conKE) strength characteristics of professional male football players across a range of joint angles and angular velocities.

2.0 Methods

2.1 Participants

An *a priori* power calculation from pilot study data identified that a sample size of 26 was required to evaluate the interactions for all independent variables (for statistical power .0.8; $P \leq 0.05$). A convenient sample of twenty six professional male football players (age 26.19 ± 4.65 years; height 181.65 ± 5.71 cm; mass 82.19 ± 9.01 kg) was therefore recruited for the current study. The participants were all full-time professional football players competing in the English football league two. Inclusion criteria specified that the participants demonstrated the capacity to complete a familiarisation trial specific to the experimental trial, were outfield players and were injury free for a minimum of 6 months prior to testing. In the two weeks prior to testing,

the participants all completed training volumes of $> 10 \text{ h}\cdot\text{week}^{-1}$ in addition to weekly friendly matches. The current study was conducted following an 8-week pre-season schedule, immediately prior to the commencement of the 2016-2017 season.

For risk stratification, all participants were required to complete a health screening procedure prior to commencement of each trial. The health screening procedure comprised the completion of a health, physical activity and pre-exercise control questionnaire and the measurement of resting heart rate and blood pressure. Values of $>90 \text{ beats}\cdot\text{min}^{-1}$ and $>140 \text{ mmHg}/90 \text{ mmHg}$ respectively were contraindications to exercise. Participants were informed of the risks and procedures involved in testing and were required to provide written informed consent prior to the commencement of the study. The experimental protocol was previously approved by the local university ethics committee and conformed to the Declaration of Helsinki.

2.2 Experimental design

Participants were required to attend the laboratory on two occasions to complete a familiarisation trial followed by a single experimental trial, separated by a minimum of 96 hours. In an attempt to control for circadian variation (Rae, Stephenson, and Roden, 2015), all experimental trials were completed in accordance with the participant's regular training times (between 10am and 12pm). Participants were instructed to attend the laboratory on each occasion in a 3hr post-absorptive state following a 48 hour abstinence of alcohol consumption. In an attempt to reduce the influence of residual fatigue on the current data, a 48 hour rest-period from

exercise was also factored into the players weekly microcycle. This was made possible due to the completion of the testing at the end of the pre-season period. Prior to the start of each trial, the isokinetic dynamometer was calibrated in accordance with the manufacturer's guidelines. During the completion of the calibration procedure, the participants were required to complete a standardised 5 minute warm-up on a stationary cycle ergometer (Monark, 824E, Sweden) at 60 W.

The experimental trial comprised the completion of a bilateral profile of the participant's eccKF and conKE isokinetic torque-angle relationship at angular velocities completed in the order of 180, 270, and 60 °·s⁻¹ (Greig, 2008) on an isokinetic dynamometer (IKD) (system 4, Biodex Medical Systems, Shirley, New York, USA) with the dominant leg defined as the preferred kicking leg. For each leg, and at each angular velocity and contraction type, participants were instructed to perform 3 maximal contractions through their full range of movement. Passive knee flexion performed at 60 °·s⁻¹ separated each repetition and a rest period of 60 seconds interspersed each set. No performance feedback was provided during any of the experimental trials. The dynamometer setup was adjusted specifically for each participant in line with the manufacturer's guidelines, with the cuff of the lever arm secured around the ankle proximal to the malleoli. Each participant was secured in a seated position with approximately 90° of hip flexion, with restraints applied proximal to the knee joint across the thigh, across the waist, and across the participant's chest. The lever arm was aligned with the axis of rotation of the knee joint and the anatomical reference was set at 90°.

2.3 Data Analysis

The isokinetic phase (disregarding torque overshoot) of each repetition was analysed and the repetition eliciting the highest angular velocity-corrected torque was subject to further analysis. Peak torque (PT) and the corresponding angle of peak torque (APT) were identified, in addition to a novel measure of functional range (FR). This FR metric was defined as the range over which 85% of PT was maintained, since a 15% decrease in PT has been associated with an increased risk of injury (Croisier et al. 2008). This FR measure also provides a measure of the torque-angle profile, a larger FR indicative of a PT value that is less sensitive to joint angle. Angle specific torque (AST) data was calculated at 10° increments across an angular range (between 40° and 70°) for all angular velocities. Strength ratios were defined as the traditional dynamic control ratio, derived from the peak eccKF and conKE values (DCR_{PT}) and angle-specific dynamic control ratios (DCR_{AST}) calculated from the AST data. In subsequent sections these parameters are annotated according to angular velocity, so that peak torque at $60^\circ \cdot s^{-1}$ is labelled as PT_{60} . For all independent variables associated with the current study, inter-class correlation coefficients (ICC's) were calculated between 0.77 and 0.82.

2.4 Statistical Analysis

The variables that were to be included were decided *a priori*. The aforementioned measures did not violate any of the assumptions, therefore inferential analyses were performed. Inferential analyses were performed using a repeated measure general linear model (GLM) to examine

differences in the isokinetic data. Where significant main effects or interactions were observed, post hoc pairwise comparisons with a Bonferonni correction factor were applied. For all significant main effects and interactions, 95% confidence intervals (CI) for differences are also presented. All statistical analysis was completed using PASW Statistics Editor 22.0 for windows (SPSS Inc, Chicago, USA). Statistical significance was set at $P \leq 0.05$. All data is reported as mean \pm standard deviation (SD) unless otherwise stated.

3.0 Results

3.1 Peak Torque

Figure 1 summarises the relationship between PT and angular velocity for eccKF and conKE. The GLM identified a significant contraction*angular velocity interaction ($P < 0.001$), with significantly higher values recorded for conKE (240.0 ± 31.6 N.m) data recorded at $60^\circ \cdot s^{-1}$ when compared to the eccKF data (188.7 ± 27.2 N.m; CI: 34.5 to 64.7 N.m; $P < 0.001$) and significantly higher eccKF (190.7 ± 43.8 N.m) data recorded at $270^\circ \cdot s^{-1}$ when compared to the conKE data (166.7 ± 28.7 N.m; CI: 9.9 to 33.9 N.m; $P = 0.001$). The GLM did not however identify a significant limb*angular velocity ($P = 0.087$) or limb*contraction*angular velocity interactions ($P = 0.192$).

****Figure 1 near here****

3.2 Functional Range

The influence of angular velocity and contraction on the FR is summarised in Figure 2. The GLM identified a significant ($P < 0.001$) contraction*angular velocity interaction with significantly higher eccKF FR ($27 \pm 11^\circ$) at $60^\circ \cdot s^{-1}$ when compared to the conKE FR data recorded at the same angular velocity ($21 \pm 8^\circ$; CI: 2 to 10° ; $P = 0.020$). Additionally, eccFK FR ($22 \pm 8^\circ$) at $60^\circ \cdot s^{-1}$ was significantly higher than conKE FR data recorded at the same angular velocity ($21 \pm 8^\circ$; CI: 2 to 10° ; $P = 0.020$). There was however no significant limb*contraction ($P = 0.678$), limb*contraction*angular velocity ($P = 0.130$), nor limb*contraction*angular velocity ($P = 0.382$) interactions.

****Figure 2 near here****

3.3 Angle of Peak Torque

Table 1 summarises the influence of angular velocity on APT. The GLM revealed a significant ($P < 0.001$) contraction*angular velocity interaction.

****Table 1 near here****

3.4 Dynamic Control Ratio Calculated from PT Data

A significant main effect for limb was identified, with significantly higher values recorded for the dominant limb (1.02 ± 0.06) when compared to the non-dominant limb (0.93 ± 0.20 ; CI: 0.01 to 0.17; $P = 0.018$). DCR_{PT} increased as a main effect for angular velocity ($P < 0.001$), with DCR_{PT270} (1.16 ± 0.25) being significantly higher than DCR_{PT180} (0.98 ± 0.25 ; CI: 0.10

to 0.25; $P < 0.001$) and DCR_{PT60} (0.79 ± 0.22 ; CI: 0.26 to 0.46; $P < 0.001$). No significant limb*angular velocity interaction was identified ($P = 0.070$).

3.5 Dynamic Control Ratio calculated from the AST data

Table 2 summarises the influence of limb dominance and DCR_{AST} , with a significant limb*angle interaction being identified ($P = 0.002$).

Table 2 near here

3.6 Angle Specific Torque

Figure 3 summarises the influence of joint angle on the angle matched conKE and eccKF torque at each angular velocity. The GLM identified significant contraction*angular velocity*angle ($P < 0.001$) and contraction*angular velocity*limb*angle ($P = 0.001$) interactions, as identified in Table 3.

****Table 3 near here****

****Figure 3 near here****

4.0 Discussion

The incidence of thigh musculature and knee joint injuries is a primary concern in football (Ekstrand et al. 2011; Hagglund et al. 2013). The primary aim of this study was to conduct a comprehensive isokinetic profile of the knee flexors and extensors in professional male players. The PT exhibited a significant contraction*angular velocity interaction; whilst eccKF strength was

maintained, conKE strength decreased as a function of increasing angular velocity. The DCR was subsequently greatest at the highest angular velocity, with greater eccKF strength compared to conKE at angular velocities $> 200^{\circ}\cdot\text{s}^{-1}$.

The eccKF also exhibited a significantly greater FR at the highest angular velocity. The FR is used to consider the shape of the strength curve, with a higher value indicative of a capacity to maintain $\geq 85\%$ of PT (Croisier et al., 2008) across a broader range of motion. The FR was higher for the eccKF at all angular velocities, but exhibited a contraction*angular velocity interaction whereby range decreased with increasing angular velocity. When considering the typical injury aetiology associated with knee flexor injuries (Woods et al. 2004), the observed reduction in FR at high velocities might have implications for injury risk during the completion of ballistic movements. Practitioners involved in injury screening should therefore consider a players ability to maintain strength over a given range of motion (i.e. FR) at high angular velocities.

The DCR data also exhibited a main effect for limb, with higher values recorded for the dominant limb. There was however no difference between limbs for PT, thus supporting previous observations of no significant bilateral strength differences in elite soccer players (Fousekis, Tsepis and Vagenas, 2010; Daneshjoo et al., 2013). In contrast, the AST data was significantly higher in the dominant knee flexor musculature, with more pronounced differences recorded at increased knee extension angles. Isokinetic profiling

should therefore incorporate the analysis of AST data to identify potential bilateral asymmetries which may predispose players to greater risk of injury (Croisier et al. 2008; Kim and Hong, 2011). This is of particular importance given the influence of limb dominance on the incidence of knee flexor injuries (Svensson et al., 2016).

The lack of influence of angular velocity on eccKF PT supports previous research (Westing et al., 1988). In contrast, Greig (2008) reported increased eccKF PT with increasing angular velocity, attributed to lower torque values at slow angular velocities compared with the present study. This might reflect the calibre or training status of the players used. The increase in strength ratios with increased testing angular velocity is in agreement with previous research (Kellis, Arabatzl and Papadopoulos, 2003; De Ste Croix, Deighan and Armstrong, 2007; Hewett, Myer and Zazulak, 2008) and attributed to decreased knee extensor strength. Contrary findings have reported that the DCR decreases with increased knee extension (Cohen et al. 2015; El-Ashker et al. 2015), but these data were recorded closer to full extension and/or at increased angular velocities.

The current data recorded at high angular velocities and extended joint angles synonymous with lower limb injury risk demonstrate increased eccKF PT and FR when compared to the conKE contractions. The observed discrepancies in the eccKF and conKE PT data also results in an increased DCR_{AST} recorded at high angular velocities. In contrast, the current conKE strength data was however identified as being greater than the eccKF data

but only during slow ($60^{\circ}\cdot\text{s}^{-1}$) angular velocities and at flexed knee positions (70°), where knee flexor strain and knee ligamentous injury typically do not occur (Boden et al., 2000). It has previously been suggested that the risk of sustaining a knee flexor strain or ligamentous injury is greater during high velocity movements during increased knee extension (Woods et al. 2004; Hagglund, Walden, and Ekstrand, 2013; Kristianslund and Krosshaug, 2011) and, as such, the observed decrease in conKE strength at high angular velocities may therefore represent an aetiological risk factor. This is contrary to literature which suggests that increased knee extensor strength is a risk factor for ACL injury (Hewett et al. 2010) and knee flexor injury (Van Dyk et al. 2017).

Both knee flexor and extensor musculature provide stability to the knee and ACL (Hughes and Watkins, 2006; Chmielewski et al., 2002), thus reducing anterior shear force and ACL injury risk (Doorenbosch and Harlaar, 2003; Kellis, Arabatzl and Papadopoulos, 2003). The knee extensor musculature also helps to absorb shock and reduces strain during the initial ground contact from dynamic movements (Podraza et al. 2010). Previous literature therefore suggests that players need to possess sufficiently developed and balanced knee flexor and extensor musculature to help cope with the demands of soccer-specific activity and reduce injury risk. The current data suggests that an increased emphasis should be placed on the development of high velocity conKE strength at increased knee extension angles.

In support of previous literature (Cohen et al., 2015; Kellis, Arabatzl and Papadopoulos, 2003), the APT data recorded for the eccKF contractions occurred at significantly more flexed positions at $270^{\circ}\cdot s^{-1}$ when compared to $180^{\circ}\cdot s^{-1}$. These data therefore suggest that the current participants possess reduced maximal strength capacity at extended knee positions, where knee flexor injuries typically occur (Chumanov et al. 2012; Higashihara et al. 2015). This is further supported by the observed reduction in FR at increased angular velocities.

The importance of considering a range of joint angles and angular velocities is apparent in the differences observed in the current APT data. Peak conKE torque was achieved at $\sim 70^{\circ}$, whereas the eccKF torque was greatest at $\sim 35^{\circ}$. The asynchrony observed in the APT data has implications for the traditional calculation of strength ratios derived from force magnitude alone (El-Ashker et al. 2015; Evangelidis et al. 2015), thus advocating the calculation of DCR_{AST} . The DCR_{AST} data recorded at $270^{\circ}\cdot s^{-1}$ is comparable to values previously reported by Cohen et al. (2015) and Evangelidis et al. (2015). However, when comparing the DCR_{AST} at slow angular velocities, the professional players tested in the current study elicited increased eccKF strength when compared to their lesser standard counterparts (Cohen et al. 2015; Evangelidis et al. 2015), thus resulting in increased DCR_{AST} data. The use of DCR_{AST} can therefore be used to differentiate between players of different playing standards, and also enables the calculation of strength ratios where ligamentous and muscular strain injuries are more likely to occur (Boden et al., 2000). For example, in the current study, the observed

reductions in conKE torque at high angular velocities and extended knee angles resulted in an increased DCR_{AST} .

The use of isokinetic dynamometry imposes some inherent methodological issues, such as a restriction on obtaining isokinetic data close to full extension where injury risk is increased (Boden and Dean, 2000; Chumanov et al. 2012; Higashihara et al. 2015). The dynamometer constraints also do not allow data collection at angular velocities higher than those used in the current study and which might more closely represent the mechanisms of injury (Dowling et al. 2012; Nedergaard et al. 2014). Irrespective of the aforementioned limitations, isokinetic dynamometry and muscular strength testing is common practice in football. It is therefore important for sports scientists and fitness coaches alike to identify the limitations of equipment, but as identified in the current study, practitioners should attempt to develop methods to better utilise equipment to further inform practice.

When considering that thigh musculature and knee ligamentous injuries typically occur in extended knee positions and at high angular velocities, practitioners should consider isokinetic testing protocols and metrics which consider these factors. The additional and novel metrics utilised in the current study may also aid practitioners in determining strength deficits associated with ipsilateral and bilateral muscular asymmetries. Improved isokinetic screening practices should also be used to inform training paradigms, developing specificity in strength and power adaptations aligned with the specific demands of football. Given gender differences in specific

injury incidences, such as ACL injury (Hewett et al., 2010); the same profiling could be applied to female players. Youth players might also be a focus, to further understand the longitudinal development of muscle imbalances in football players.

5.0 Conclusion

Professional football players were able to maintain ecckF strength over a range of angular velocities, but conKE strength decreased with angular velocity and increased knee extension angles. The influence of angular velocity has implications for the calculation of strength ratios and thus a range of angular velocities is advocated. The APT was achieved closer to knee extension in the knee extensors, and the lack of coincidence in the peak of the torque-angle curves advocates the use of AST. The FR was included as a novel isokinetic parameter which reflects the shape of the strength curve. The ecckF musculature were better able to retain 85% of PT over a greater angular range, which might serve as a protective mechanism for injury. The interaction of joint angle and angular velocity on the thigh musculature relationship has implications in injury screening and athletic performance.

6.0 References

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Figures

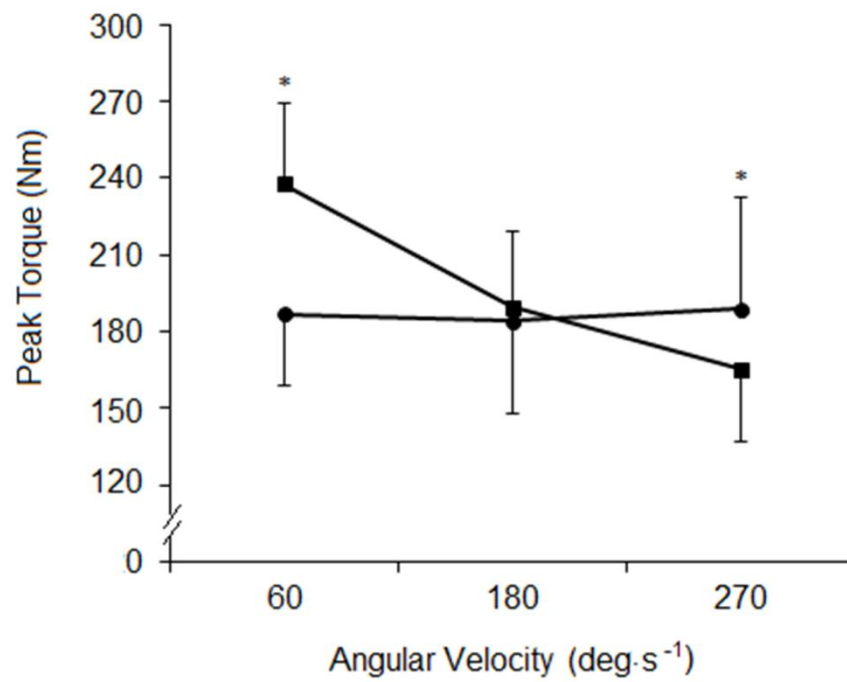


Figure 1. The influence of angular velocity on conKE (■) and eccKF (●) PT. * denotes significant difference between contraction types.

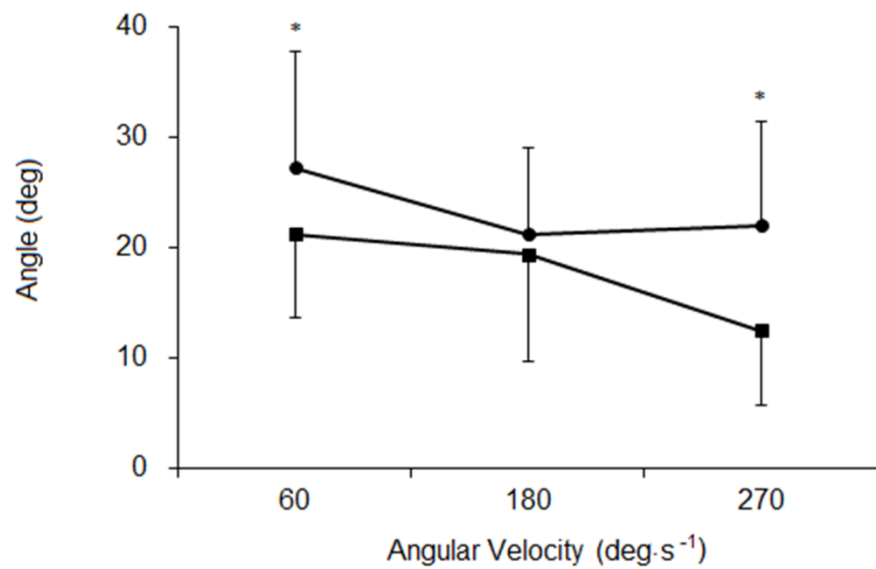


Figure 2. The influence of angular velocity on the FR (at 85% PT) in conKE (■) and eccKF (●). * denotes significant difference between contraction types.

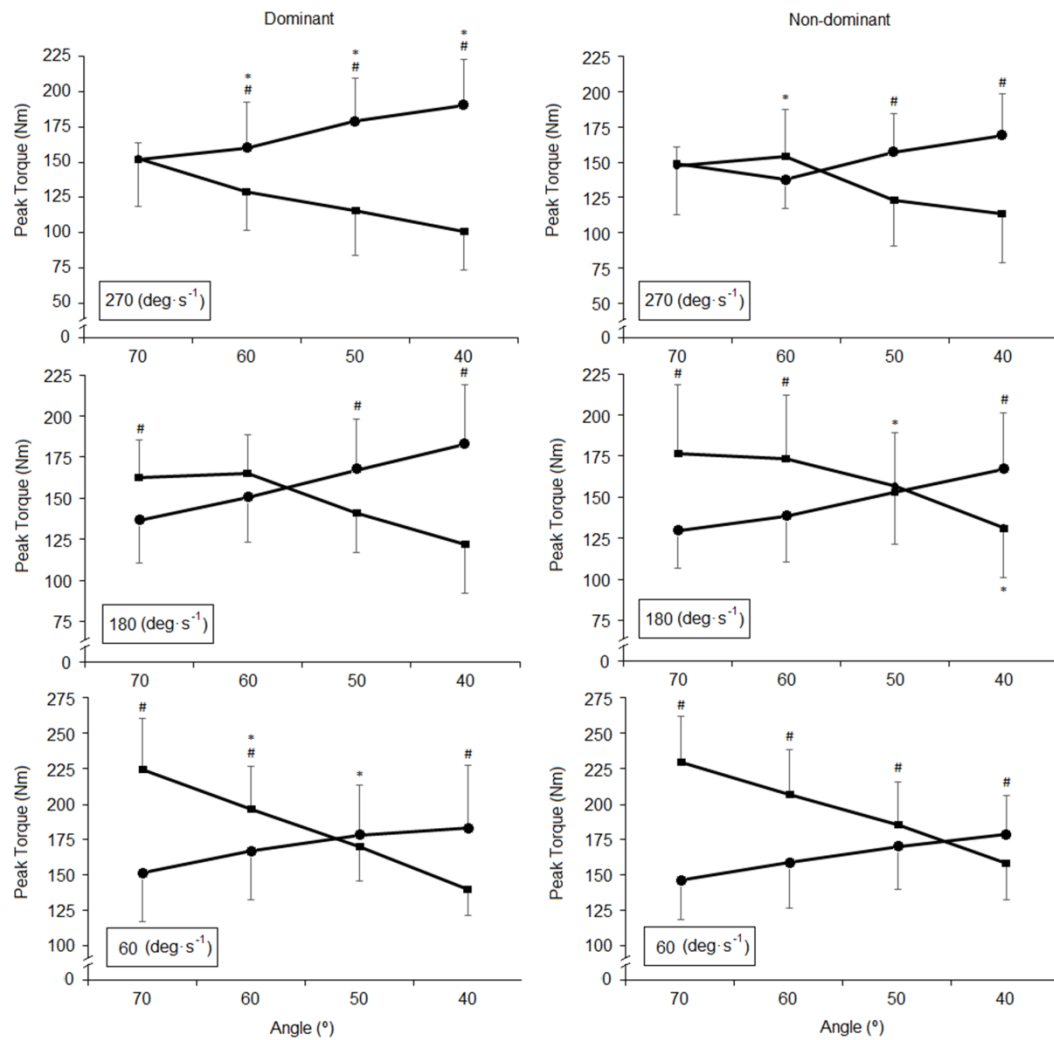


Figure 3. The influence of angular velocity on AST for conKE (■) and eccKF (●) * denotes significant difference between limbs. # denotes significant difference between contraction types.

Tables

Table 1. The influence of angular velocity and contraction type on APT. 95% CI for the significant interactions are also presented. * denotes significant difference with the corresponding data from the conKE contraction.

	eccKF APT (°)	conKE APT (°)	CI (°)
$60^{\circ}\cdot s^{-1}$	$36 \pm 9^*$	74 ± 6	34 to 42
$180^{\circ}\cdot s^{-1}$	$35 \pm 13^*$	71 ± 7	29 to 37
$270^{\circ}\cdot s^{-1}$	$45 \pm 14^*$	67 ± 7	16 to 25

Table 2. The influence of limb and angle on the DCR_{AST} data. 95% CI for the significant differences are also presented. * denotes a significantly higher value when compared to the corresponding data in the other limb.

Angle (°)	Dominant	Non-dominant
70	0.81 ± 0.23	0.82 ± 0.34
60	0.99 ± 0.21 *CI: 0.72 to 0.22	0.80 ± 0.16
50	1.24 ± 0.21 *CI: 0.03 to 0.30	1.03 ± 0.19
40	1.53 ± 0.32 *CI: 0.05 to 0.39	1.29 ± 0.26

Table 3. The influence of angular velocity, contraction type, limb and angle on the AST data. 95% CI for the significant differences are also presented. #denotes a significantly higher value when compared to the corresponding data from the other contraction type. * denotes a significantly higher value when compared to the corresponding data in the other limb.

Angular Velocity	Angle (°)	conKE (N.m) dominant	conKE (N.m) non-dominant	eccKF (N.m) dominant	eccKF (N.m) non-dominant
270 deg·s ⁻¹	70	160.7 ± 27.9	145.6 ± 34.3	152.3 ± 14.6	147.3 ± 10.8
	60	134.4 ± 20.3	152.7 ± 32.5	162.9 ± 33.9 #CI: 11.9 to 45.2 *CI: 9.7 to 40.2	138.0 ± 25.0
	50	121.2 ± 29.0	122.5 ± 28.8	182.3 ± 33.8 #CI: 44.2 to 77.8 *CI: 9.4 to 39.5	162.9 ± 33.9 #CI: 18.4 to 52.0
	40	104.9 ± 26.6	112.5 ± 33.2	193.8 ± 35.6 #CI: 72.2 to 105.7 *CI: 7.5 to 41.7	169.3 ± 32.5 #CI: 38.7 to 74.8
180 deg·s ⁻¹	70	167.1 ± 18.5 #CI: 18.6 to 42.0	175.5 ± 35.6 #CI: 28.5 to 62.1	136.8 ± 26.2	130.2 ± 24.9
	60	163.8 ± 31.2	173.5 ± 39.4 #CI: 21.8 to 46.8	151.3 ± 27.5	139.2 ± 30.8
	50	140.3 ± 24.7	156.7 ± 32.6 *CI: 3.2 to 29.6	168.3 ± 32.3 #CI: 11.7 to 44.4	153.0 ± 34.2
	40	117.9 ± 24.0	132.1 ± 32.6 *CI: 1.46 to 26.9	185.2 ± 37.1 #CI: 80.9 to 83.6	168.5 ± 36.9 #CI: 25.2 to 47.5
60 deg·s ⁻¹	70	230.4 ± 35.3 #CI: 66.2 to 101.4	228.1 ± 33.8 #CI: 81.6 to 107.9	146.6 ± 27.6	146.6 ± 27.6
	60	200.2 ± 30.1 #CI: 26.4 to 49.1	202.0 ± 35.7 #CI: 41.1 to 68.0	162.4 ± 30.3	162.4 ± 30.3
	50	171.5 ± 24.2	177.8 ± 35.2	177.8 ± 35.2	175.5 ± 37.3
	40	140.7 ± 18.9	140.7 ± 18.9	184.8 ± 49.4 #CI: 24.4 to 63.6	184.8 ± 49.4 #CI: 11.8 to 37.9